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AN

ESSAY

ON THE

SENSES OF SMELL AND TASTE;

TO WHICH WAS AWARDED

THE PRIZE OF THE BOYLSTON MEDICAL SOCIETY

IN 1863.

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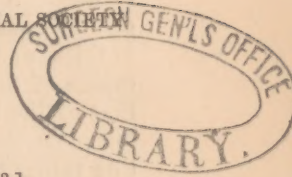
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THE SENSES OF SMELL AND TASTE,

AN ESSAY TO WHICH THE PRIZE OF THE BOYLSTON MEDICAL SOCIETY
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By NORTON FOLSOM.



[From the Boston Medical and Surgical Journal for April 23, 1863.]

THESE senses are so mingled in action, that their separate offices are at first difficult to determine; and even the exact locality of the perceptions which constitute the two senses can hardly be pointed out without careful observation. We instinctively know that we smell odoriferous substances when they are presented to the nose, and that we taste sapid substances in the mouth, but more than this we can only derive from experiment.

The anatomy of the mouth and nose is briefly as follows: The mouth is an oblong cavity, with an arched roof, lined with mucous membrane, and opening into the pharynx through the arches of the palate. It contains the tongue, which is a muscular organ, capable of applying itself to any part of the mouth, and covered also with mucous membrane, which presents, on the dorsal aspect, three kinds of papillæ; first, the circumvallate, seven to fifteen in number, about one fourth of an inch in diameter, soft, and arranged in the form of the letter V at the root of the organ; second, the fungiform, soft, but much smaller than the circumvallate, distributed irregularly over the dorsum, but much more numerous at the tip and edges; and third, the filiform, very minute, and quite hard and stiff, covering the whole upper surface, between the other papillæ. The epithelium of the circumvallate and fungiform varieties is very thin, that of the filiform quite thick and tough.

The hard palate is the roof the mouth. Attached to its posterior border, and hanging like a veil or curtain between the mouth and pharynx, is the soft palate, which is muscular, and capable of being applied to the posterior wall of the pharynx, so as to entirely separate the cavities of the nose and the mouth.

The pharynx is the upper extremity of the œsophagus, and opens above into the posterior nares. These parts are all covered with mucous membrane, continuous with that of the mouth, and, like it, consisting of the laminated pavement-epithelium.

The nose consists of two pyramidal cavities, opening externally in front, and into the pharynx behind. They are entirely separated by a cartilaginous septum. Each cavity is partially divided by three spongy bones into three passages, called respectively the superior, middle, and inferior meatus. All these parts are covered with mucous membrane, which differs in character, however, in different localities. As far down as the middle spongy bone, the epithelium is of the "squamoso cylinder"* variety, not ciliated, and the membrane is thick and brownish. Below this, and as far posteriorly as the orifice of the Eustachian tube, the epithelium is ciliated, exactly like that of the larynx and trachea, from which we might infer that this lower portion of the cavity is associated with the respiratory function rather than with special sensation, as is indeed the case.

The nearly-closed cavities communicating with the nostrils, namely, the ethmoidal cells, the sphenoidal and frontal sinuses, and the antrum of Highmore, have no connection with the sense of smell, as has been repeatedly demonstrated by experiment in regard to the two last mentioned.†

The nerves distributed to these organs are as follows:

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|---------------|--|
| To the nose, | { <ol style="list-style-type: none"> 1. The olfactory. 2. Branches of the first and second divisions of the trifacial. 3. Branches from the spheno-palatine ganglion of the sympathetic. |
| To the mouth, | { <ol style="list-style-type: none"> 1. Branches of the third division of the trifacial. 2. The glosso-pharyngeal. 3. The hypo-glossal. 4. Branches from the spheno-palatine and otic ganglions. |

The olfactory nerves, within the cranium, arise from the base of the brain, and rest upon the cribriform plate of the ethmoid bone, which is immediately over the superior spongy bone. From it arise filaments, which descend upon the septum and upon the superior and middle spongy bones, and cannot be traced farther down than the non-ciliated mucous membrane extends. They differ from ordinary nerve-fibres in wanting the axis-cylinder, and in their gelatinous consistency and gray color. They terminate, according to late investigators, in club-shaped bodies, lying immediately beneath the epithelium, which are presumed to be ganglion-cells, like those which constitute the gray cerebral matter.‡

The nasal branches of the first and second divisions of the trifacial supply the mucous membrane of the nose throughout.

* Kalliker. *Human Microscopical Anatomy*.

† J. Müller. *Elements of Physiology*.

‡ Oehl, as quoted in the *Year Book of the New Sydenham Society* for 1859.

Ecker, as quoted by Schroeder Van der Kolk in researches "on the Spinal Cord and Medulla Oblongata."

The sphenopalatine and otic ganglions send branches to the nasal mucous membrane, and also to the muscles of the soft palate.

The branches of the third division of the trifacial supply the mucous membrane of the mouth, and a large trunk called the gustatory nerve is distributed to the anterior two-thirds of the dorsum of the tongue, where its fibres enter the fungiform papillæ.

The glosso-pharyngeal nerve supplies the muscles and mucous membrane of the pharynx and base of the tongue, and a branch passes forward to the circumvallate papillæ, where it forms a considerable plexus in each of them.

The hypo-glossal is distributed exclusively to the muscles of the tongue.

In a morphological point of view, the olfactory apparatus is to be considered as a cerebral ganglion, belonging, with the eye and the ear, to a series of three organs of special sense, which are disposed in the intervals between the four cranial vertebræ. Their nerves differ from ordinary nerves in having ganglion-cells, or gray matter, at their peripheral extremities, namely, the olfactory filaments, the retina, and the cochlear and vestibular branches of the auditory nerve. This view is corroborated by the original development of these nerves or ganglions, which grow out from the cerebral substance, instead of being formed *in situ*, as all other nerves are.

In considering the functions of these various nerves, we may exclude the fibres from the sympathetic (believing them only to govern the nutrition of the parts, and to cause certain involuntary movements of the palate), and the hypo-glossal, which is the motor of the tongue.

When a substance to be tasted is placed in the mouth, we press it with the upper surface of the tongue against the palate, and thus force its particles in every direction. The saliva, poured in by its glands responsive to the stimulus, aids in dissolving and disseminating the particles over the mouth. When the substance reaches the fauces, and as it is swallowed, a current of air escapes from the glottis and carries any volatile portion to the posterior nares, where it is liable to affect the sense of smell. Plainly, therefore, in order to separate the two sensations, we must either shut off the cavity of the nose during the tasting, which can be done by most persons voluntarily by breathing through the mouth and applying the soft palate to the back of the pharynx, or we must interrupt the current of air through the nares, which can be done by holding the nose with the fingers.

We recognize two classes of impressions made by articles of food—one of *savors*, of which salt affords an example; the other of *flavors*, as that of vanilla. Most substances have both properties; thus a strawberry has an acid and a sweet taste, besides its own delicious flavor.

The distinction between these two classes has not, indeed, been fully made by physiologists until of late; and still less has the fact been recognized, that *all flavors are perceived by the organ of smell only*, reducing the number of impressions which the organ of *taste* is capable of receiving to four only, viz., Sweet, Sour, Salt, and Bitter. This can, however, be easily and certainly demonstrated. Let the nose be closed by the fingers, or let the posterior nares be shut off by the soft palate, and a solution of vanilla be taken into the mouth and swallowed. It cannot be distinguished from water. Soup, nutmeg, cheese, pineapple, and assafoetida are alike entirely *flavorless* under similar conditions, though the *ordinary sensibility* of the mucous membrane, and the perception of the four savors above mentioned, may enable us to apprehend certain *other* qualities which distinguish these substances. The common practice of holding a child's nose while it swallows disagreeable medicine, has its origin in this peculiar relation of these two senses.

We have now to consider the exact locality of the sensations produced by these four classes of stimuli. Experiments have been tried by various physiologists with entirely different results, which may be attributed to want of care and to not recognizing the fact that all *flavors* should be excluded from the investigation. All agree, however, in this—that, to be tasted, a substance must be brought to the sensitive part *in solution*, inasmuch as insoluble substances have no taste.

In the experiments performed by the writer, solutions of white sugar, tartaric acid, common salt, and sulphate of quinine, were carefully applied to various parts of the mouth and fauces by means of a camel's-hair pencil, pains being taken that no excess of fluid should be used, which might diffuse itself over other parts than that directly under observation. The following results were uniformly obtained on six different individuals, they all being unaware of the substances used in each experiment.

1st. The upper surface, tip, and edges of the tongue, as far back as to include the circumvallate papillæ, are the *only* parts concerned in the sense of taste; the hard and soft palate, tonsils, pharynx, lips, gums, and under surface of the tongue being entirely destitute of this sense.

2d. The circumvallate papillæ are far the most sensitive portion of the organ. They perceive, at once, very minute quantities of any one of the four substances used, and are particularly sensitive to bitter. Irritation of these papillæ by pressure, or placing a drop of cold water on them, excites decided sensations of bitterness.

3d. The central portion of the dorsum of the tongue, to within half an inch of the edge, is the least sensitive portion. Substances are distinguished with difficulty, or not at all, when applied to it.

4th. The edges and tip of the tongue are quite sensitive, the

edges becoming less so as we come forward. They recognize all the four classes of substances. The tip detects bitter with great difficulty, but is particularly sensitive to sweet. A sweet sensation, sometimes mingled with sour or salt, is produced by gently tapping it with any insipid soft substance.

The tongue possesses *ordinary sensibility* to a marked degree, especially at its tip, and in this way detects the size, shape, and texture of substances. It is in the same way that the qualities of pungency and astringency are perceived, which fact is proved by their being nearly as perceptible to the conjunctiva, or any other mucous membrane possessing ordinary sensibility, as to the mouth. A solution of tannin, applied to the circumvallate papillæ, gives the sensation of extreme bitterness, while at the tip it produces a slight sweetish taste, especially after it has been washed off by the saliva. These sensations are entirely distinct from the puckering, which, as just said, is perceived by other mucous membranes. The application of a solution of potassa gives nearly the same result, proving that there is no such thing as a distinct alkaline taste.

The results of the experiments of the present writer differ from those of a recent authority,* who states that the hard and soft palate possess the sense of taste to a considerable degree. It is difficult to prevent fluids applied to these parts from trickling down upon the tongue; but if this is guarded against, no sensation is produced, even by a strong solution of a sapid substance, except that of stimulation.

These facts make it almost certain that the gustatory branch of the trifacial, through the fungiform, and the anterior branch of the glosso-pharyngeal, through the circumvallate papillæ, share the office of tasting between them. This is also proved by cases where the sense of taste has been lost in the anterior part of the tongue, by the paralysis of the trifacial nerve, while it continued unimpaired at the root.†

We should hardly expect to find this similarity of action between two distinct nerves, especially as the whole of the trifacial, with the exception of the gustatory branch, is a nerve of ordinary sensation. But it is shown by recent microscopic investigation, that the sensitive root of the trifacial nerve receives certain fibres from the root of the glosso-pharyngeal in the substance of the medulla oblongata,‡ and it is at least *possible* that these fibres may enter the lower division, and be distributed with the gustatory branch, thus giving it the power of tasting.

These nerves do not differ in structure from the nerves of ordinary sensation, and yet would seem to perform the office of special

* Drielsma, as quoted in the Year Book of the New Sydenham Society for 1860.

† Todd and Bowman. Physiology.

‡ Schroeder Van der Kolk, in researches "on the Spinal Cord and Medulla Oblongata."—New Sydenham Society. 1859.

sense. But tasting is, as we have seen, a much simpler action than at first appears, and should rather be classed with the functions of hunger, thirst, satiety, nausea, and the distress which is felt impelling us to breathe when respiration is suspended, (functions performed by the pneumogastric,) than with the higher and more complicated special senses. In connection with this, we may notice that, morphologically, the glosso-pharyngeal and pneumogastric belong to the same pair of cranial nerves.

Certain substances have been observed to produce sensations, painful or otherwise, when applied to perfectly sound teeth. As it has been ascertained that fluids are readily and rapidly absorbed by the tubules of the dental structure, and conveyed to the pulp cavity,* it is highly probable that the sensation is excited at the latter organ.

The sense of smell is entirely performed by the olfactory nerve. This is proved by the corresponding increase of the relative size of the nerve in those animals which are known to possess a particularly acute power of scent, and also by the fact that in paralysis of the trifacial the sense remains unimpaired. The branches of the trifacial which are distributed to the mucous membrane of the lower and anterior parts of the nasal cavity, endow it with a high degree of *common sensibility*, so as to guard the more delicate part of the organ from injury, by giving warning if we attempt to inhale any irritating vapor. This common sensibility appreciates the pungency of substances in the same way as in the case of any other mucous membrane. Many substances possess pungency beside odor, as ammonia and mustard, for example. These affect the conjunctiva almost as readily as the nose.

The organ of smell is affected by substances only when they are in the form of vapor; hence non-volatile substances have no smell. Vapors reach the organ in two ways. In the first place, a current of air may be drawn, by a forcible inspiration, so as to be directed by the external nose to the upper part of its cavity, and impinge upon the filaments of the olfactory nerve. If this air contains particles of any volatile substance, it gives rise to the sensation which we call *odor*. In the second place, if any volatile substance is taken into the mouth, and carried to the fauces, or swallowed, and a puff of air is allowed to escape from the larynx, it will be directed by the walls of the pharynx, so as to carry the particles of the substance directly to the upper part of the nares, where it produces what we describe as *flavor*. We unconsciously emit this current of air, immediately after swallowing, and when we are trying to taste anything. Thus we see that "scent and flavor are the same impression on the same nerve at the same part."†

Flavors are connected, in a great majority of instances, with food. This is the reason that the smell of roast meat so strongly

* Dr. Miel, a dentist, as quoted by Todd and Bowman.

† Herbert Mayo. *The Nervous System and its Functions*. 1842.

excites the appetite of a hungry man. The exercise of the sense of taste is simultaneous with that of smell, in the act of eating, which accounts for the difficulty of distinguishing between them.

We can only classify these perceptions so far as to say that they are agreeable or disagreeable. Even this distinction cannot always be made; thus the faint smell of putrid urine closely resembles that of sandal-wood. What is offensive to one person may be pleasant to another. The desire for certain flavors is entirely acquired, and the infant will reject with loathing what may become its favorite food in after life. An agreeable flavor or odor sometimes becomes disagreeable by long continuance.

The odors of substances which are similar in other respects are generally alike, so that we may attempt to classify them according to the sources from which they are derived. The smells of plants are nearly, if not quite all, derived from essential oils. The various ethers have kindred odors.

Substances differ as to the intensity of their odor without reference to their volatility. Thus the smell of musk is more intense than that of ether.

In man, this sense only serves the purpose of giving him pleasure, and guides him to a slight extent in the choice of food; but with the lower animals, it not only becomes necessary in the detection and selection of food, but warns of the approach of friends or enemies, and performs numerous other duties, sometimes attaining a delicacy which renders it nearly equal in rank to sight and hearing. The hunting-dog and the antelope are well-known examples of this. The sexual appetite is frequently excited through this sense.

But in man, this sense is not commonly developed to its fullest possible extent. It is well known that the senses possess a certain sort of compensating power; that is, if one is lost, the others become more acute. The capabilities of this sense in the human being are well exemplified by the case of James Mitchell, who was blind, deaf and dumb from birth, and distinguished between persons principally by smell. It enabled him to detect the entrance of a stranger at once.*

It is recorded of the wine-tasters of Spain, that they can distinguish between five hundred different kinds of wine; and instances are familiar to every one, of the faculty of telling several kinds of wine, or several varieties of the same kind, many times in succession, with the eyes covered. A well-known gentleman of Boston is an example.

The tea-tasters to be found in great commercial cities acquire very nice discriminating powers, frequently determining the investment of large sums of money by merely tasting a specimen of tea.

Persons accustomed to the use of tobacco can at once distinguish

* Carpenter. Human Physiology.

the variety brought from Havana, and even, in some instances, the particular plantation from which it comes.

The French cultivate the olfactory sense to a much greater extent than most other nations, not only in the art of perfumery, but in cookery, which becomes almost a fine art with them; and there seems to be no reason why the imagination should not be reached through this organ as well as through the eye and the ear. The scent of the freshly-opened rose, or the flavor of the strawberry, has as valid a claim to the notice of the poet as the song of the lark, or the beauty of sunset. At all events, much pleasure and practical advantage might be gained by its systematic cultivation, even if we should never rival the powers of "the Monk of Prague, mentioned in the *Journal of the Learned of the Year 1684*."

"He not only knew different Persons by the Smell, but, what is much more singular, could, we are told, distinguish a chaste Woman, married or unmarried, from one that was not so. This Religious had begun to write a new Treatise on Odours, when he died, very much lamented by the Gentlemen who record this Story of him. For my Part, I do not know whether a Man of such Talents would not have been dangerous to Society." *

* *Le Cat. A Physical Essay on the Senses. 1750.*

